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*Title:* **Radioactive Liquid Wastewater Treatment Facility Influent Minimization Study**

*Author(s):* Patricia Vardaro-Charles
Bryan J. Carlson

*Submitted to:* Rick Alexander, FWO-WFM

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## EXECUTIVE SUMMARY

As the result of a high volume daily base flow received by the Radioactive Liquid Wastewater Treatment Facility (RLWTF) during the Cerro Grande Fire (May 8-20, 2000), personnel were required to man the plant to treat wastewater during this general emergency shut down. This posed personnel safety risks and brought to light that a large percentage of the flow was associated with facility functions other than programmatic work.

In an effort to identify the sources of this base flow, the Environmental Stewardship Office (ESO) funded and managed an RLWTF Influent Minimization Study. The Study reviewed all historical documentation on RLW connections at other facilities and then performed a walkthrough to verify connections. Of the 20,000,000 Liters per year (LPY) of annual flow to the RLWTF, a total of approximately 8,700,000 LPY of potential reductions were identified. Of this total, the ESO identified two significant wastewater reduction opportunities that accounted for almost 3,500,000 LPY of flow, the TSTA cooling tower and TA-48 Boiler. Removal of these sources of influent is now being implemented and will reduce the total flow to the plant by 17%.

RLWTF is now installing additional tankage for influent flows. This tankage will aid in alleviating the need to man the plant during emergency shut down situations. The other reduction opportunities identified in this report must be weighed against an increase in contaminant concentrations, how the increase will increase plant operational costs and the cost to implement proposed influent reductions.

# 1.0 Introduction

## 1.1 Background

The Radioactive Liquid Wastewater Treatment Facility (RLWTF) has been treating aqueous low-level wastewaters at Los Alamos National Laboratory (LANL) facilities since 1963. The plant treats approximately 20,000,000 liters per year (LPY) of wastewater. There are 1,800 drains attached to the RLW industrial collection system that connect 15 technical areas, 13 facility management units, and 62 buildings to the TA-50 plant. Technical Area 54 does not have direct connections to the main RLW industrial waste line and wastes from this area are trucked to the TA-50 plant. RLW-WFM also operates a treatment facility at TA-53. The remainder of technical areas discharge wastewater directly to RLWTF through the plant's main industrial line.

During the Cerro Grande fire general emergency stand down (May 8-20, 2000), the plant received an average of approximately 29,000 liters per day (LPD) of base flow into the plant via the main industrial line (Figure 1). The site-wide suspension of operations at LANL required all facilities to discontinue facility and programmatic work for approximately two weeks, yet this base flow was received at RLWTF. To ensure State and Federal permit compliance, TA-50 staff was required to treat this daily flow even though the Laboratory was under general emergency shutdown conditions.

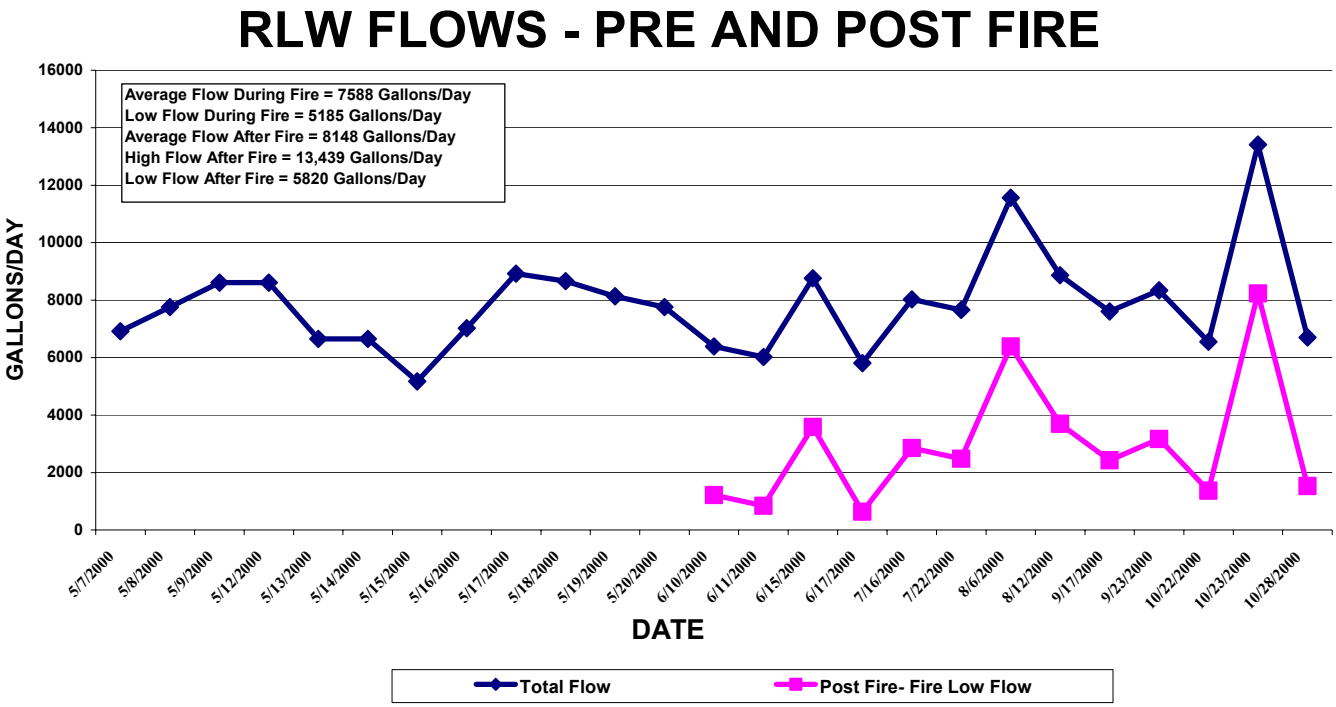



**Figure 1:** ***Influent into the RLWTF via the Plant's Industrial Line - Pre and Post Fire.***

RLW-WFM has reasoned that this flow was generated from facility equipment such as boilers and other facility support equipment that were not shutdown during the fire. After the general emergency had been lifted, LANL was placed under "normal operations", line management reviewed facility programmatic work and a staged restart of this work was initiated. Post-fire flows to RLWTF remained approximately the same until early August when programmatic functions began operations and the RLWTF began to see programmatic supported flows (Figure 1).

As can be seen in Figure 2 below, a base flow of approximately 21,000 Liters/day were received at the plant during the Christmas and New Year holiday shut down. This flow rate was close to the flows seen during the Cerro Grande Fire.

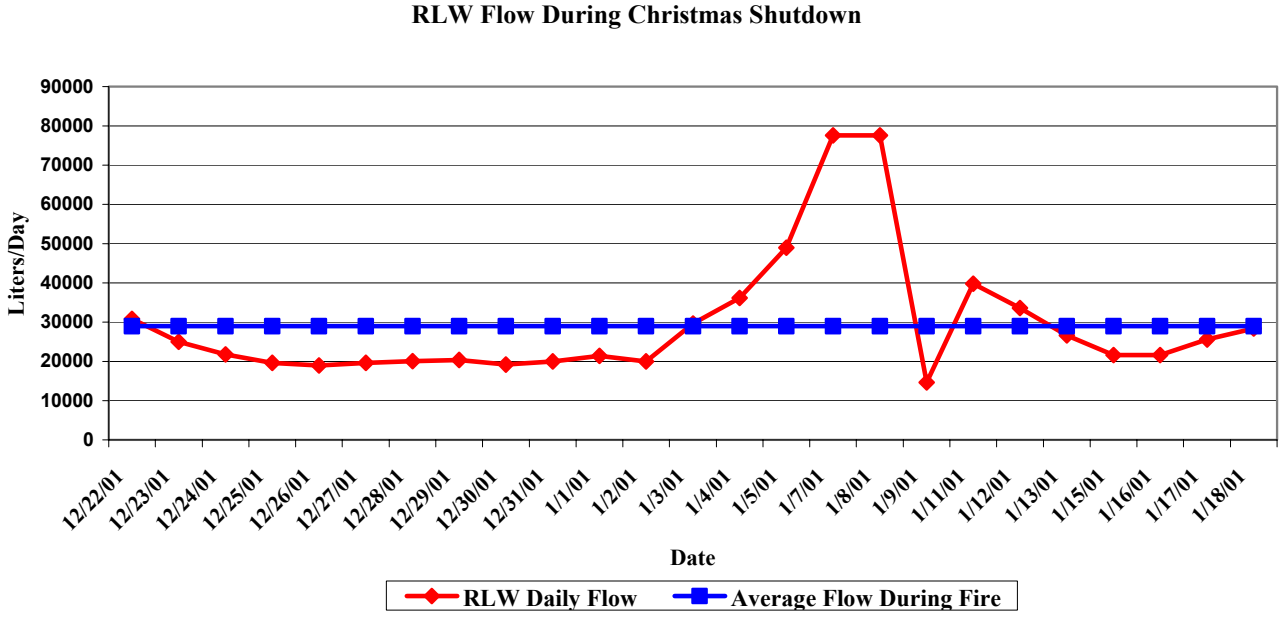



**Figure 2:** ***Base Flows Received by RLWTF during Laboratory-Wide Christmas Shutdown.***

Most of the connections to the main industrial line have been in place for over 35 years. Laboratory mission needs have changed over the years and some connections within technical areas previously used for discharges to RLW are no longer needed. In addition, operational issues that required various facility equipment to discharge to RLWTF are no longer valid. This study will focus on identifying facility drains that could be taken off of the RLWTF system due to programmatic changes and identifying facility equipment connected to TA-50 that could be taken off of the system with the application of engineering controls or equipment replacement.

### 1.2 Purpose

The focus of the Influent Minimization Study was to review facilities/activities at LANL that discharge effluent into radioactive waste drains. A compilation of candidate sources for removal from the RLWTF is the deliverable for this project with a list of recommended actions to eliminate these flows. The sources and recommended actions are noted in this report for management review.

The project goal was to identify approximately 3,800,000 LPY (or 20% of total flow) of influent wastewater that could be eliminated from the RLWTF system. This decrease in flow could result in the reduction of unnecessary operational costs, personnel risk, and would reduce the volume of wastewater treated at TA-50. Because most operational costs are a yearly fixed cost, the return on investment to implement changes is not expected to be significant. Reducing influent flows may increase the amount of reverse osmosis (RO) concentrates requiring processing (See Attachment A). These costs will tend to keep the overall operational costs constant.

### 1.3 Scope

The scope of this study was to identify sources of non-radioactive wastewater discharged to the RLWTF collection system, review if there was still a requirement for the source waste to be discharged to TA-50 for treatment, and provide recommendations to RLW-WFM for source elimination.

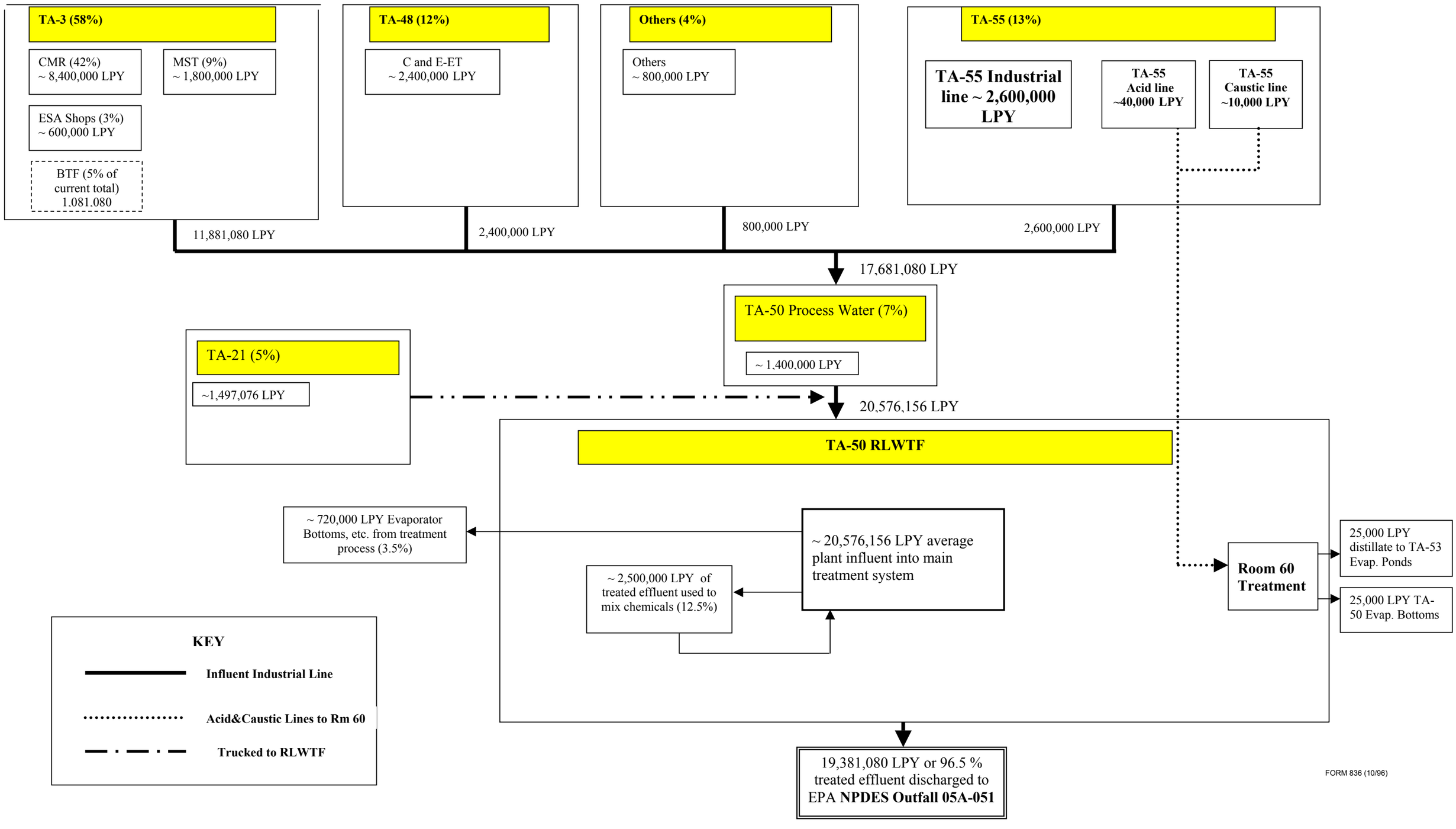
The Environmental Stewardship Office (ESO) sponsored the Influent Minimization Study where $100,000 was budgeted for completion of this task in fiscal year 2001. Monies from this budget not used to perform the study have been earmarked to provide funding for source elimination. Two sources of non-radioactive wastewater have been identified for elimination using these monies and RLW-WFM has requested ESO to fund the removal of these source waters. Therefore, the scope of this project has been expanded to include funding and project management of the rerouting project to ensure the elimination of these two wastewater sources are completed. As a result of the study and its recommendation, other rerouting projects that are considered high priority for removal from the RLW collection system should be funded by the activities responsible for implementing the recommended actions.

## 2.0 RLWTF Influent Minimization Study Findings

### 2.1 Current Influent – Flow Diagram

The following flow diagram (Figure 3) illustrates the yearly flow volumes from each major facility connected to the RLWTF. The telemetry units at most facilities are not operational and the exact volume of wastewater discharged from

FIGURE 3 - RLWTF ESTIMATED INFLUENT FLOW DIAGRAM

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each facility is unknown. Hence, this diagram is an estimate. The average influent volume of 20,000,000 LPY is used. Relative percentages of radioactive liquid waste influent discharged by the various generator facilities at LANL were estimated by the RLWTF.

## 2.2 Influent Reduction Opportunities and Recommendations

Table 1 lists the opportunities for reduction found during the facility walkarounds and recommended changes for management review. Because it is unknown how much flow is contributed from each facility, and because of difficulties in making measurements for the conditions found, the flow rates and volumes are estimates and may not accurately reflect actual rates and volumes.

**Table 1:** ***RLWTF Influent Minimization Study Findings and Recommendations.***

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **73** | 03-1 | 03-66-P100 | Electroplating baths – Steam is used to heat the baths; condensate is routed to RLW | 8.3 LPM to bring average number of baths (6) up to temperature.<br><br>4.2 LPM to maintain average number of baths at temperature. | Assume bath heating 1 hr to bring bath up to temp 11 hrs to maintain temperature. This is a 5 day/week 12 hr/day operation 850,200 LPY | NO RAD ASSOCIATED This waste stream was routed to RLW because of concern that heat exchanger would fail and allow acid and/or cyanide waste to be returned to Steam Plant boiler. Recommend that a review be performed to deduce whether condensate must continue to go to RLW or if it can be sent back to the Steam Plant. Perhaps an engineering change to ensure heat exchanger breakthrough does not occur. This system is run manually. |
| **73** | 03-2 | 03-66-P100 | Water Fountain | Nil | Nil | NO RAD ASSOCIATED Fountain is used infrequently. Determine whether it can be disconnected. If not, determine whether it would be worth the cost to reroute. |
| **73** | 03-3 | 03-66-H107 | Slate Saw – Water-cooled. | 7.6 LPM intermittent | Assume saw is used 5 hr/week 2280 LPY | NO RAD ASSOCIATED Sanitary collection line runs close to saw. Costs for rerouting saw should be minimal. |
| **73** | 03-4 | 03-66-H107 | Table Planer | Not Used | Not Used | NO RAD ASSOCIATED Disconnect. |
| **73** | 03-5 | 03-34-BSMT | Chemical Hoods | Not Used | Not Used | Disconnect. |
| **73** | 03-6 | 03-34-111 | Lab Sink | Not Used | Not Used | Disconnect. |

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **73** | 03-7 | 03-34-108 | Water Cooled Welder | 7.6 LPM | Assume welder is used 5 hr/week 2280 LPY | NO RAD ASSOCIATED Bldg. 34 has a chilled water process loop. Researcher (John Sarrao) did not want to use loop due to water quality. FM installed a filter, regulator, and flow meter and instructed researcher to use closed loop system. Provide informational training to ensure researcher(s) use closed loop system. |
| **73** | 03-07 | 03-141-108B | Washing Machine | 8.7 LPM | Total daily volume expected to be 4158 LPD or 1,081,080 LPY | NO RAD ASSOCIATED. This washing machine launders beryllium contaminated PPE's. This is a new flow to RLWTF. There is an approved WPF. However, chemicals in washing detergents were not descriptive enough and some of these chemicals are not compatible with RLWTF process (dispersant and sequestering agent). Recommend that facility re-evaluate sending laundry out as launderables, or setting up a pretreatment unit to remove organics, or evaluate if beryllium can be filtered out and send waste steam to SWSC. |
| **73** | 03-8 | 03-141-SUMP | Sump Basin | Runoff | Runoff | NO RAD ASSOCIATED This sump collects wastewater from drains in building 141 and pumps the waste to building 66 where waste is routed to the RLWTF industrial line. The enclosure sump basin seal is leaking allowing runoff to collect in the sump basin. FM is rectifying this problem. |
| **65** | 03-9 | 3-29-1100 – Wing 1 | Water Fountain | Nil | Nil | NO RAD ASSOCIATED Disconnect or reroute. Wing 1 converted to office space. As-builds should be updated and provided to RLWTF. |

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **65** | 03-10 | 3-29-2124-Wing 2 | Condenser | 4 LPH | Assume 5 day/week, 24 hr/day 24,960 LPY | RAD ASSOCIATED Condenser used for experimental work in controlled lab. Experimenter claims that the flow is 4 LPH, however this was not verified. Experimenter claimed that the use of a chiller was not considered because of contamination issues. Re-evaluate if a chiller could be used. |
| **65** | 03-11 | 3-29-2023-Wing 2, Wing 5, Wing 7 | 2 vacuum pumps per Wing that provide vacuum for process operations, one on-line at all times, one on stand-by. | 1.3LPM | Assume vacuum is supplied to glove boxes 365 day/yr, 24 hr/day 683,280 LPY<br><br>All Wings with same assumption 2,049,840 LPY | RAD ASSOCIATED During walkthrough, observed Wing 2 vacuum pump was in operation and discharging water to a RLWTF drain. Observation was not made in Wings 5 or 7. CMR Operations Center personnel have stated that these pumps are on a closed loop system and there is no discharge associated with them. The flow rate and volume in this report is a rough estimate and the actual discharge needs to be further investigated. If needed and if appropriate, pump replacement or engineering change.<br><br>In Wings 3, 4, and 9, these pumps are not expected to be used again. |
| **65** | 03-12 | 3-29-Wing 2, Wing 3, Wing 4, Wing 5, Wing 7 | Water Fountain in hallway outside controlled laboratories | Nil | Nil | NO RAD ASSOCIATED Disconnect if practical. |

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **65** | 03-13 | 3-29--Wing 2, Wing 7 | Cooling Water Evaporators | 3.78 LPM | High estimate that assumes a load is supplied to one wing CWE 8 hr/day, 5 day/week, 51 week/yr 462,672 LPY<br><br>Same assumption for both wings currently operating: 925,344 LPY | RAD ASSOCIATED<br>During walkthroughs, Wing 2 CWE in room 2195 was discharging. The CWE in room 2295 was not discharging, nor were any of the other CWEs in other wings. Blow down is dependent on load from laboratories. The discharge from these units can be quite significant.<br><br>In Wings 4, 5, and 3, the CWEs have been dismantled and in Wing 9, they do not use the CWE and don't have plans to use.<br><br>Review if an engineering change such as an alarm system and automatic shutdown on the heat exchanger could be installed. May be able to be operated off of a conductivity meter. |
| **65** | 03-14 | 3-29-Wing 2, Wing 7 | CWE re-circulating water loop | Unknown | Unknown | RAD ASSOCIATED<br>The chilled water coming from the CWEs is stored in a water tank in basements of wing 2, 5, and 7. Chilled water is circulated to laboratories from the water tank. If power is lost, water is gravity drained to water tank. If the tank is full, the tank overflows into the RLW industrial line. |
| **65** | 03-15 | 3-29-Wing 2, 3, 4, 5, 7, 9 | Showers in equipment rooms (adjacent to rooms where CWEs are located) | None | None | NO RAD ASSOCIATED<br>Showers are not used for decontamination any longer and in fact are not used at all. One shower was leaking. Disconnect. |

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **70** | 03-16 | 3-102-Tech Shop | Shower | 30.24 LPM | Shower is used every day by 5 workers (5 day/week, 51 week/yr). Assume average shower length is 10 minutes. 385,560 LPY | RAD OPERATIONAL ISSUE Tech shops work with depleted uranium. Machinists wear PPE's and monitor before going to shower area. Recommend showers be rerouted to Sanitary. If reroute is impractical, switch showerheads to low flow that would reduce flow to as low as 5.67 LPM or 72,330 LPY (81% reduction from this source). |
| **71** | 3-17 | 3-65 | Drains | None | None | NO RAD ASSOCIATED This building is being converted to office space. Six drains in this building should be rerouted to the SWSC or removed. |
| **70** | 21-1 | 21-420 | Cooling Tower | 2.8 LPM | Assume blow down discharges 24 hr/day, 365 day/yr 1,490,076 LPY | RAD OPERATIONAL ISSUE No contamination issues associated with blowdown. The recommendation was to reroute this cooling tower to an existing 03A outfall. This job is has been initiated (start date June 18, 2001) and will be completed by June 30, 2001 as per RLWTF request. |
| **73** | 35-1 | 35-213-C105 | Vacuum Pump | 7.6 LPM | Assume pump is used 4 weeks/year, 7 days/week and 24 hr/day 306,432 LPY | NO RAD ASSOCIATED Vacuum pump is installed in a small (approx. 5' wide and 14' long) room. Because of this, a chiller was deemed impractical. To decrease flow, researcher put flow regulator on, but discharge is still quite substantial. The contaminant in pump is acid and researcher uses this type of pump to address the low pH. Determine if recirculating and maintaining smaller bleed can decrease flow. Research if other types of pump can replace. |

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **66** | 48-1 | 48-1-244 | Boiler | 3.2 LPM (as high as 4.11 LPM). Different flow rates reflect skimmer valve adjustments by boiler crew. | Assume 7 days/week, 24 hr/day, 365 day/yr 1,677,312 LPY (low est.) 2,154,297 LPY (high est.) | RAD OPERATIONAL ISSUE No contamination issues associated with blow down. The recommendation was to reroute the boiler blow down and drain to the Sanitary. This job will be initiated and completed this FY as per RLWTF request. |
| **66** | 48-2 | 48-1-various | Laboratory Sinks Rooms 309, 310, 414, 414B, 412 | 0.315 LPM | Assume 7 days/week, 24 hr/day, 365 day/yr and sink is leaking 1 gallon/hr 165,110 LPY | RAD ASSOCIATED Provide this information to C-FM for maintenance activities. |
| **66** | 48-3 | 48-1- 1st floor hallway | Ice Machine | None | None | NO RAD ASSOCIATED This ice machine is an air-cooled unit. However, the dump valve could fail which would lead to signification volumes of water being discharged to the RLW system. Recommend that this ice machine be rerouted to the Sanitary. |
| **66** | 48-4 | 48-1-16 | Unknown | Unknown | Unknown | UNKNOWN RAD ISSUE ¼" hose running from room 16 to an RLW drain. Could not access room. Recommend that this source be identified and volume determined. |
| **66** | 48-5 | 48-1-Hot Cells | Condensers | 1.9 LPM intermittent | Assume 3 condensers are being used 4 weeks/yr, 5 days/wk, and 12 hr/day. 81,648 LPY | RAD ASSOCIATED Recommend supplying chillers. |

| FMU | ID | Location (TA-Bldg-Room) | Description | Estimated Flow | Estimated Volume | Recommendation |
|---|---|---|---|---|---|---|
| **71** | 59-1 | 59-1-B7, B8F, B8H | Sinks | Nil | Nil | NO RAD ASSOCIATED Recommend reroute to Sanitary for B7 and disconnect sinks in B8F and B8H. Sink in B7 is in janitor's closet, but is not in a controlled area. Sinks in B8F and B8H are labs that have been converted to office space. |
| **71** | 59-2 | 59-1-roof | Air Scrubber | Unknown | Unknown | Verify how this system is operated and PMs. Verify discharge volume and determine if volume can be reduced. |
| **71** | 59-3 | 59-1 | Unknown | 40 LPM every 1.5 hrs. | 640 LPD or 233,600 LPY | According to RLWTF flow meter for TA-59-1, approximately 40 LPM is discharged from TA-59 about every 1.5 hrs. This would be indicative of the 20-gallon sump filling up and then pumping. No source for this regular release was found during the walkthrough. Recommend dye tests be run on the drains that were rerouted from 03A098 outfall during the outfall reduction program to ensure they were not routed to RLW. |
| | | | | | | |
| | | | | | | |

## 2.3 Current Influent Minimization Efforts

Two rerouting projects are currently underway, that will eliminate approximately 3,500,000 LPY from the RLW system. The successful elimination of these two sources will meet the project goal of eliminating approximately 20% of the influent from the RLW system. Specifically the two projects scheduled for rerouting are the TA-21 TSTA cooling tower and the TA-48, Building 1 boiler.

At this time, no other influent minimization projects are underway. After review of the findings and recommendations, RLWTF management will determine if continued efforts to eliminate flows are necessary or desirable.

### 2.4 Scheduled Influent Projects – Flow Diagram

The following flow diagram (Figure 4) represents what the estimated flow into TA-50 after the two scheduled rerouting projects have been completed (see Section 2.3). Potential reduction opportunities from Section 2.2 are also listed on the flow diagram. The estimated relative percentages of average influent volumes from each facility have been recalculated from the RLWTF estimate.

### 2.5 Other Significant Findings

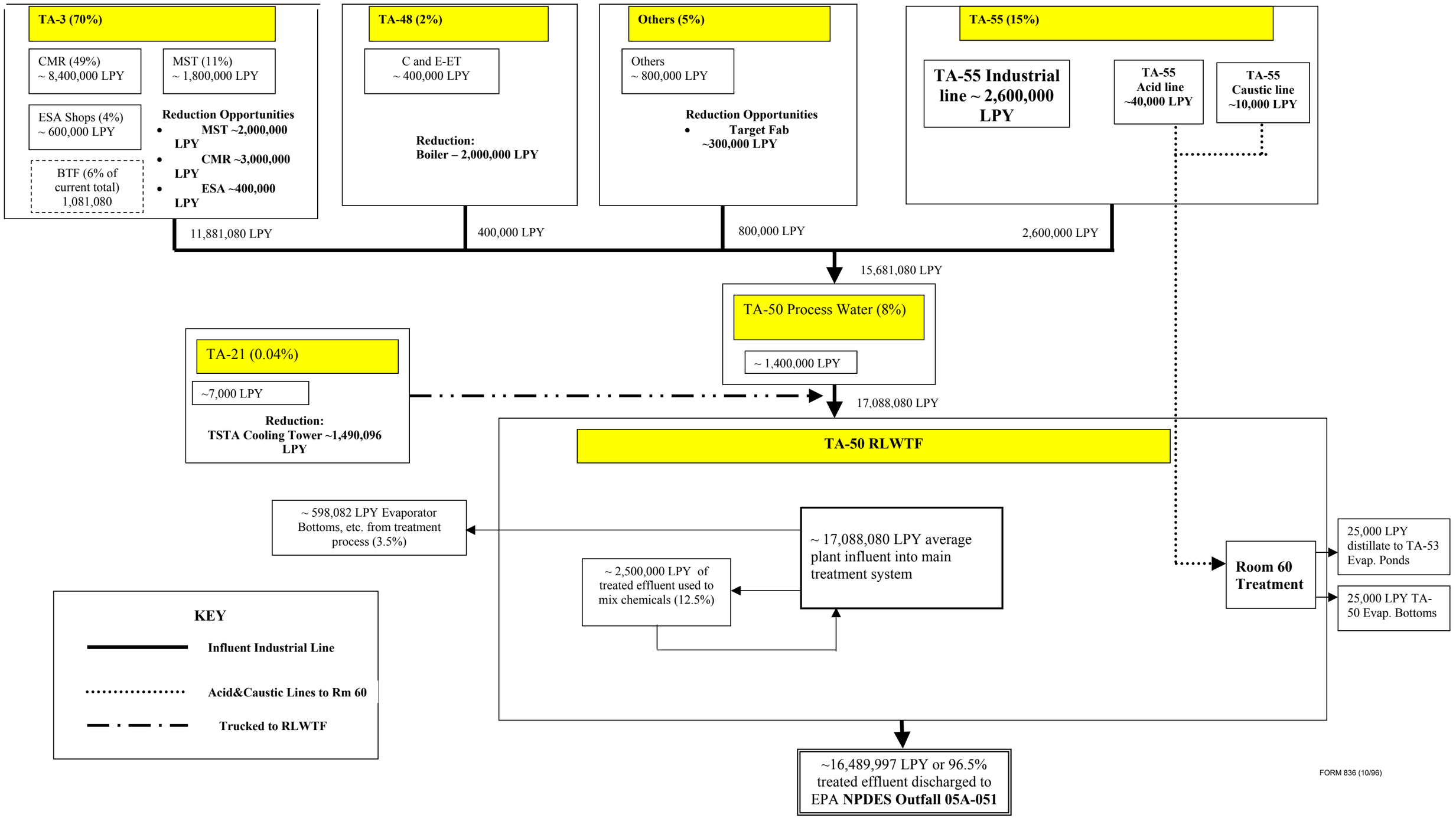
During the course of this study, the investigator found other conditions that are not related to wastewater discharge reductions, but were deemed noteworthy for inclusion in this report. The following lists those findings:

- RLWTF telemetry units were not operational in most of the facilities visited.
- The connections to the RLWTF for the following facilities do not correctly reflect the 1994 Wastewater Stream Characterization reports and RLWTF should request new facility connection drawings from the appropriate FMUs:
    - Beryllium Treatment Facility,
    - Target Fabrication Facility,
    - Sigma (need to identify which drains go to the cyanide tank and which drains go into acid tank), and
    - CMR all Wings.
- Wastewater for all CMR Wings go directly into the industrial wastewater line, and no longer goes into holding basins.
- CMR duct washing system is not being used. However, they plan to bring this operation back on line once they have an approved WPF in place. This will greatly increase the flow going into the RLWTF industrial line.
- CMR Air Handlers do not discharge to the RLWTF. They are permitted to a 03A NPDES outfall.
- CMR is the only facility that has a waste profile form in place for janitorial wastes. Waste profile forms for all facilities should be in place or a laboratory-wide waste profile form should be developed.

## 3.0 Conclusions

As a result of this study and the funding allocated for its completion, the influent treated at the RLWTF will be reduced by 17% by the end of fiscal year 2001. This reduction is resultant of the TA-21 cooling tower blow down reroute and the TA-48 boiler reroute. Additional opportunities for wastewater elimination are possible and could result in reductions as much as 43% of the total average flow received on a yearly basis. However, future wastewater elimination efforts must be weighed with costs the facility may incur by treating a more concentrated waste stream.

FIGURE 4 – RLWTF ESTIMATED INFLUENT FLOW DIAGRAM WITH TA-21 AND TA-48 REROUTES

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## 4.0 Need for Future Work

The investigator was unable to set-up a walkthrough of TA-55-PF4. Because TA-55 is a major contributor to the main industrial line, this walkthrough should be completed.

The washing machine at the Beryllium Treatment Facility is a major new source of wastewater to RLWTF. If the discharge from this new system cannot be eliminated from the RLWTF, options to decrease the flow, and options to replace chemicals that are counterproductive to the plant's treatment process should be thoroughly investigated.

A waste profile form for all janitorial wastes should be pursued by RLWTF. The SWSC has a general waste profile form in place for all janitorial wastes and this new profile form could be modeled from the SWSC.

**ATTACHMENT 1**
**Cost Analysis of Reducing Influent Flow to the RLWTF**

Effluent tanks discharged from 6/1/00 – 5/31/01

| | No. of Tanks | % of Tanks | Volume (liters) |
|---|---|---|---|
| All TUF Permeate | 93 | 41.5 | 6,818,219 |
| All RO Permeate | 54 | 24.1 | 3,959,496 |
| Mix of TUF/RO Permeate | 67 | 29.9 | 4,912,404 |
| Evaporator Distillate | 10 | 4.5 | 739,325 |
| **Totals** | **224** | **100** | **16,429,444** |

Effluent tanks discharged from 6/1/00 – 5/31/01 with TUF/RO mix tank volumes separated

| | No. of Tanks | % of Tanks | Volume (liters) |
|---|---|---|---|
| All TUF Permeate<br>+ TUF from Mixed Tanks<br>***Total TUF Tanks*** | 93<br>+ 36.75<br>*129.75* | 57.9 | 9,512,648 |
| All RO Permeate<br>+ RO from Mixed Tanks<br>**Total RO Tanks** | 54<br>+ 30.25<br>*84.25* | 37.6 | 6,177,471 |
| Evaporator Distillate | 10 | 4.5 | 739,325 |
| **Totals** | **224** | **100** | **16,429,444** |

## Average of RDF monthly composite samples from June, 2000 through May, 2001:

**Nitrate-Nitrogen = 8.5 mg/L**
**Gross Alpha = 19.6 nCi/L**

The costs for handling RO concentrate for the past 12 months (6/1/00 – 5/31/01) was estimated at approximately $850,000. During this time period, the total flow discharged from the plant was 16.5 million liters and the effluent was 60% tubular ultrafilter permeate and 40% reverse osmosis permeate.

If non-alpha and low nitrate flows decrease (for example the TA-21 cooling tower blowdown and the TA-48 boiler are taken off line), then the average concentration of nitrate and gross alpha will increase. This will increase the percentage of time that water must be processed by the RO (see Table 1 below). The increase in RO usage will increase the production of RO concentrate. This increase in RO concentrate will increase the usage of the EDR with a volume reduction factor of 4.0 ($2/gallon), operation of the interim evaporator with a volume reduction factor of 4.0 ($7/gallon), and shipment of bottoms to GTS ($14/gallon).

**Table 1 RO Usage as a Function of RLWTF Influent Flow Reduction**

| Percent Flow Reduction | Percent RO Usage |
|---|---|
| **0** | **40** |
| **10** | **52** |
| **20** | **59** |
| **30** | **65** |
| **40** | **72** |

The following chart exhibits the costs associated with handling the RO concentrate stream when the non-alpha and low nitrate flows are reduced. It is expected that the removal of these flows from the RLWTF influent will increase the use of the RO unit in processing the RLWTF effluent. The chart indicates that no cost savings, in processing the RO concentrate secondary stream, will occur by reducing the flow to the RLWTF.